Ballistic plate

A **ballistic plate**, also known as an **armour plate**, is a protective armoured plate inserted into a carrier or bulletproof vest, that can be used stand-alone, or in conjunction with other armour. "Hard armour" usually denotes armour that uses ballistic plates.

A pair of Small Arms Protective Insert plates, circa April 2006. These were issued to US Army units, before being replaced by the ESAPI.

It serves to defeat higher threats, and may be considered as a form of applique armour. It is usually inserted into the front and back, with side inserts also sometimes used. There are also plates for other regions, such as the shoulders,[1] lap, and throat.[2]

Dimensions and sizing

Ballistic plates can be found in a variety of sizes and shapes.[3] In the industry, armour plate shapes are common referred to as a cut, in reference to how the strike face must be cut from the material. The most common are the:

- SAPI Cut, a rectangle with two sloped cuts on the top two corners, the name being derived from the SAPI armour plate. Similar, but with larger cuts, is the Shooter's Cut.
- Swimmer's Cut, similar to a stretched trapezoid on top of a rectangle. Used by SEALs and other seaborne units.
- Rectangle/Square, a rectangular armoured plate with rounded off corners. Somewhat antiquated due to the advent of modern tooling.

Some other cuts exist, but are far less used, such as the ergonomic cut, which covers most of the torso, and the ranger cut, which has largely fallen out of favour for much the same reasons as square.

Most overt armour plates usually are sized to 250 mm × 300 mm (10 in × 12 in), 280 mm × 360 mm (11 in × 14 in), and other such dimensions, however SAPI plates are slightly different.[4] In addition, armour plates may be curved to assist in the user's comfort and ergonomics.

Materials

Most ballistic plates are made of a combination of materials. The following categories denote the primary material used in different plate packages.

Ceramic

Ceramic plates or ceramic armor, typically composed of boron carbide, silicon carbide, or other similar materials, are common place in military applications. The advantages of ceramic armor is that they are not only lighter than metals, but much harder as well, which enables them to deform tungsten core penetrators, and resist ammunition at a high velocity.

Ceramic material defeats projectiles by shattering it into pieces, decreasing the penetration ability of projectile. Compared to steel or titanium, ceramic plates have inferior multi-hit resistance due to its somewhat brittle nature, although there are workarounds, as with the IM/PACT technologies demonstrated by Ceradyne, which use a stainless steel crack arrestor,[5]

or the titanium arrestor of the newest GRANIT GOST 6A armoured plates fielded by Russia's Armed Forces.[6]

As such, they are vulnerable to projectiles which hit in a tight grouping, as these create a stress concentration on the plate and shatter the section of plate targeted.[7]

Metal

Most metal ballistic plates are made primarily of steel or titanium, although aluminum and various alloys also exist. Steel plating, although it suffers less deformation, may suffer greater impulse generated by an impact, as the steel bends very little, and thus little energy is captured. A steel plate shatters a projectile, sending potentially dangerous fragmentation across the plane of the plate.[8] In addition, metal armour has the possibility of deflecting bullets, where they may end up in a limb, friendly personnel, bystanders, or private property. Munitions above 3100 fps have been known to penetrate commercial armour steel plates sold under NIJ Level III, most notably the 5.56 M193 round.[9] As well, the most common material, AR500 steel, or Abrasion Resistant/ Brinell Hardness 500 steel, is actually not created for armour purposes, and thus can suffer major variances in hardness According to Leeco Steel, "While often requested for ammunition target surfaces, AR500 steel plate is not certified for ballistic use".[10]

Plastic

Multi-layered sheets/plates of ultra high molecular weight polyethylene (UHMWPE) can provide an added ballistic enhancement equal to or even greater than metal plates with less weight. With these, there is the cost of less trauma reduction and the improbable but possible risk of fracture. UHMWPE can be strewn into a thread when made, and woven into a fabric that competes in strength, flexibility, and weight to modern aramid fabrics, and is now a commonly used material in vests. UHMWPE however, does have weaknesses, most notably it's vastly inferior heat and flame resistance due to being a thermoplastic with a low melting point(130 degrees °C, or 266 degrees °F), and they should not be exposed to temperatures above 100 °C for prolonged periods of time. These composites also tend to bulge up quickly when shot as a result of the delamination.

Nanomaterials

As a potential material for future ballistic plates and anti-ballistic fabrics, carbon nanotube and nanocomposite materials offer strength to weight ratios that are potentially superior to other materials. For further information on these materials as applied to ballistics, please visit the section on ballistic vest nanomaterials in ballistics. There are plates made of nanomaterials currently available in commercial products.

References

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External links

- Ballistic Resistance of Body Armor NIJ Standard-0101.06 (https://www.ncjrs.gov/pdffiles1/nij/223054.pdf)

- International Testing Standards for Personal Body Armor (http://www.ballistics.com.au/technical/ballisticandstabstandards.php)
- How does a bullet proof vest work? (https://web.archive.org/web/20100212234321/http://www.bodyarmornews.com/bullet-proof-vest.htm)

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